Telic
Telematics & Telemetry

SBC-AVL
User Manual

Version 2.4

SBC-AVL / SBC-AVL Power

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1 Overview

The SBC-AVL family of products from Telic is an innovative telematics unit offering a wide range of tracking and monitoring configuration options.

The extremely small form factor combined with high quality performance enables the user to deploy the SBC-AVL in a variety of applications. The SBC-AVL is designed for deployment in passenger cars, any type of commercial vehicles, fleets of taxis, rental cars or in public transportation vehicles.

The SBC-AVL is available in the following two variants:

SBC-AVL	SBC-AVL Power
Ideal for advanced track and tracing applications. In addition to general purpose inputs and outputs, SBC-AVL supports also 1-wire and CAN bus interfaces.	Ideal for advanced track and tracing applications, where also security features are required, such as a backup battery or GSM jamming. In addition to general purpose I/Os, SBC-AVL Power supports also 1-wire and serial interfaces based on LVTTL.

Table 1: The different versions of the SBC-AVL

2 Applicable Products

This user manual is applicable for the following products:

	SBC-AVL		SBC-AVL Power	
Part Number	04000		04001	
HW Revision	D3f	D4i	D3g	D4j
Serial No.	0404<IMEI>	0406<IMEI>	0405<IMEI>	0407<IMEI>

3 Delivery Content

In addition to the SBC-AVL, the following accessories can be part of the shipment, if previously ordered.

Accessory Name	Order code	Functionality	Picture
Connection cable SBC AVL	16032	Automotive molex cable for on vehicle installation	
Cigarette lighter charger SBC-AVL	17024	Charger cable for connecting the device to the Cigarette lighter	
OBD II Power Supply Cable	17023	2-pin OBD-II connector cable for power supply only; Cable length: 1 m	
OBD II CAN Cable	17027	4-pin OBD-II connector/cable for power supply + CAN High/Low; Cable length: 1 m	
RS232 Level Shifter	16105	Level shifter from LV-TTL (3.3V) to RS232 (12V); Open Wires (VCC; GND; RS232 Rx &Tx; TTL Rx & Tx); Cable length: 1 m	
1-wire Temperature Sensor	90029	1-wire Temperature sensor; Cable length: 7 m; Temperature range: -55 °C to +125 °C; Accuracy: ± 0,5°C (in range -10 °C to +85 °C)	

Table 2: Accessories

4 SBC-AVL Components

Feature	SBC-AVL	SBC-AVL Power
Certifications	E1, FCC[1]	
GSM/GPRS	Quad Band	
Receiver Type	56-channel GPS engine	56-channel GPS engine
GSM Jamming Detection	Yes	Yes
Housing	Small & Compact Design	
Antenna Connector	Internal	
Interface Connector	10-pin Molex	
Status Indicators	3 LEDs (GSM; GPS; Battery)	
Ignition Status (On/Off)	1x	
General Purpose Inputs	1x	
Digital Outputs	1x (300 mA max; low side switch) [2]	2x (300 mA max; low side switch) [3]
1-Wire	• iButton ID key • Temperature Sensor (DS18S20; DS18B20; DS1921G)	
CAN Bus	Configurable CAN; OBD-II; FMS	--
RS232 / UART	--	1x (LVTTL; 3.3V)
USB	Configure & Trace	• Configure & Trace • Battery charging
Message Storage Capacity	~ 20000 (location data only)	
External voltage range	7V - 32V	
Battery Capacity	--	660 mAh (LiPo)
Typical consumption in sleep Mode (@12V) - external source	≤ 0,5 mA	
Typical consumption in sleep Mode (internal battery)		≤ 0,08 mA
Dimensions	74x49x20 mm	
Operating temperature	-30°C to +75°C	
Recharging temperature	N/A	0°C to +45°C

Table 3: Components of SBC-AVL and SBC-AVL Power

[1] This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference; (2) this device must accept any interference received, including interference that may cause undesired operation.
[2] Applicable from hardware with serial numbers 0406<IMEI> or higher.
[3] Applicable from hardware with serial numbers 0407<IMEI> or higher. Earlier hardware versions support 1x digital output.

5 Operating Set up

The operation set-up of the tracking and tracing module can be realised in few quick steps.

	Please take proper ESD protection measures (e.g. electrical connection of the body to ground) to make sure you don't destroy internal electronics! Repair of ESD damages caused by user's negligence will not be covered by Telic's warranty. Electrostatic discharge (ESD) is the sudden and momentary electric current that flows between two objects at different electrical potentials normally caused by static electricity.

5.1 Operating the device

Please open the SBC-AVL housing by pushing the button shown here:

Figure 1: The button to open the SBC-AVL Housing

While keeping the button pushed remove the top cover with the other hand as shown. The SIM card holder can be found under the top cover.

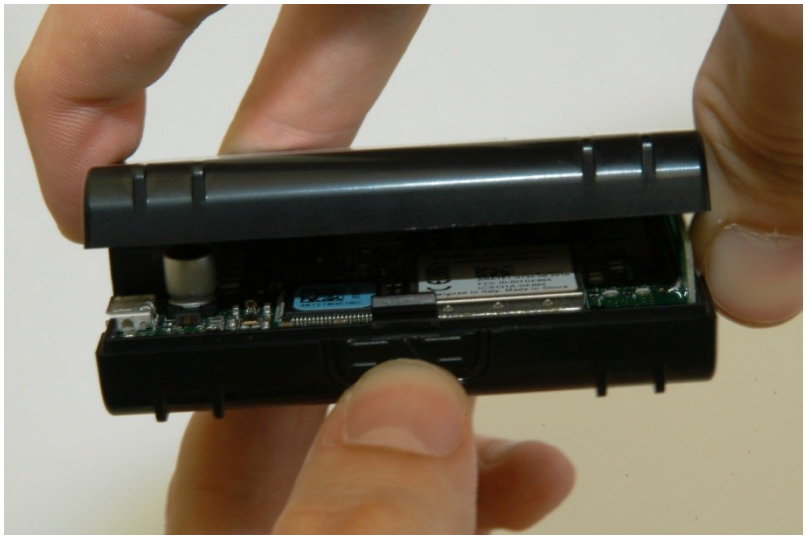

Figure 2: How to open the SBC-AVL Housing

5.2 Insert the SIM Card

A working SIM card from a suitable network provider must be properly inserted in order for the device to operate correctly.

	If the SIM card is not PIN free, it has to be ensured that the PIN is set to "0000". To speed up the log-in process into the GSM network, the SIM card should contain no or only a few phone book entries.

	The messages of the SBC-AVL are transmitted via the mobile GSM network. Therefore you need a standard 3 Volts or 1.8 Volts SIM card. Please give preference to post-paid SIM cards!

The insertion of the SIM card into the SBC-AVL is easy:

- Place the device in front of you on the desk such showed in the picture.
- Slide the SIM card cover carefully on left.

Figure 3: How to insert the SIM Card

- Carefully flip the card reader sideways then up. Now insert the SIM card into the SIM card holder so that the cut corner matches with the corresponding marking on the SIM card holder. Do not touch the contacts of the SIM card. If necessary clean the contacts with a soft cloth.

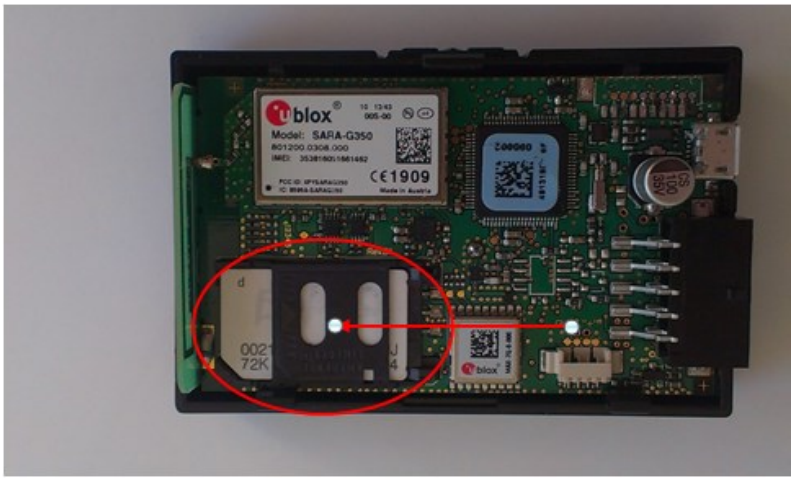

Figure 4: Where to insert the SIM Card

- When inserted correctly the gold contacts of the SIM card should be facing down.
- Flip the SIM card holder back into its original position and slide the lock back on right till it is locked
- If you cannot close the SIM card holder, you may have inserted the SIM card in the wrong direction

With this step you have finished the SIM card installation

5.3 Close the cover

Please close the SBC-AVL housing by pushing the top cover against the down side until there is no-more space between the 2 surfaces.

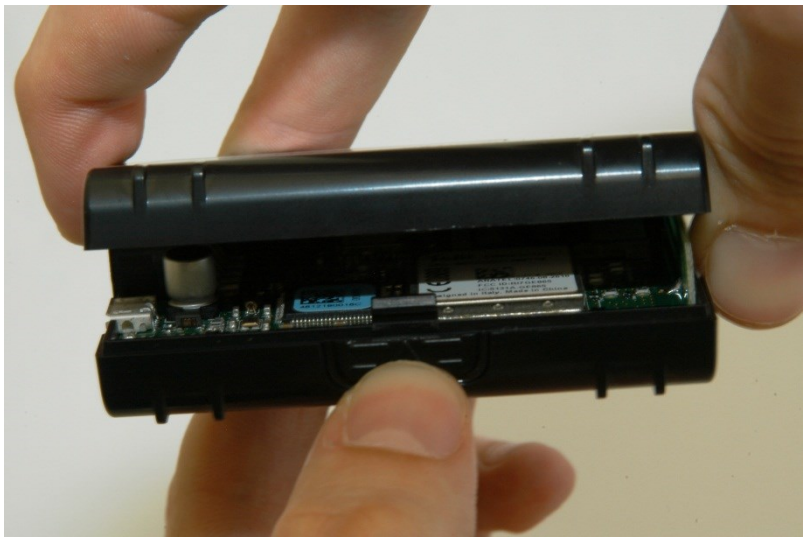

Figure 5: How to close the SBC- AVL Housing

5.4 Powering up the device

The SBC-AVL needs to be connected to a power source (7 – 32 volt direct current). It can be powered by a car battery, a rechargeable battery or a stabilized DC power supply. The USB connector is available only for tracing and configuration functionalities; in case of the SBC-AVL Power, it can also be used to charge the internal battery. If the SBC-AVL is connected only to the USB port, without VCC and GND the GPS and GSM modules will remain switched off, even when the device is connected to the USB port, it will not go into any kind of sleep mode. The SBC-AVL Power version else is able to power up GPS and GSM modules also while just connected to the USB port, without main power.

5.4.1 Wiring description

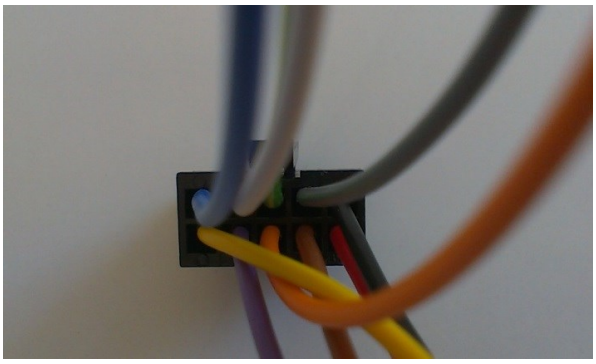

Figure 6: SBC-AVL Cable Pin allocation

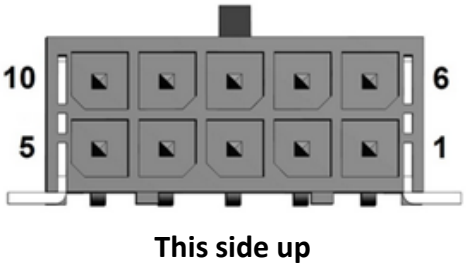

Figure 7: SBC-AVL Connector

Signal	Cable Color	Connection	SBC-AVL	SBC-AVL Power
VCC /IN 3	Red (pin 1)	Required	X	X
GND	Black (pin 6)	Required	X	X
IGNITION INPUT (1)	Yellow (pin 5)	Recommended	X	X
DIG_IN 2 (ANA_IN1)	Violet (pin 4)	Optional	X	X
1-wire	Grey (pin 7)	Optional	X	X
DIG_OUT1	Orange (pin3)	Optional	X [4]	X
DIG_OUT2	Brown(pin2)	Optional		X [5]
CAN-H	Brown(pin2)	Optional	X	
CAN-L	Green (pin 8)	Optional	X	
RS232 LVTTL RX	White (pin 9)	Optional		X
RS232 LVTTL TX	Blue (pin 10)	Optional		X

Table 4: SBC-AVL Cable Color description

[4] Applicable from hardware with serial numbers 0406<IMEI> or higher.
[5] Applicable from hardware with serial numbers 0407<IMEI> or higher.

5.5 LED behavior

Left indicator: Power supply status	Middle Indicator: GSM status	Right Indicator: GPS status
The left indicator consists of a red one. SBC AVL: When the LED is off, the device is not powered. SBC AVL Power: When the LED is off, the device is not powered even in sleep mode.	The orange LED reflects the GSM status and also whether the device is switching on When the LED is off, the GSM Module is not active.	This LED blinks green and indicates the status of the GPS receiver Off: GPS is not switched on
 SBC-AVL: Blinking once: Device is powered (7- 32V) Blinking twice: Powered only via USB (GSM/ GPS off) **SBC- AVL Power:** Blinking once: Powered (7-32V) and internal battery fully charged Blinking twice: Low battery voltage On: Internal battery charging	 Permanently on: GSM is active, but no GSM networks available / not yet registered. Blinking once: Device is logged into the GSM network, no connection to server Blinking twice: Device is logged into GSM network, GPRS is attached, established TCP/ IP connection to server A very short flash while the device is in sleep mode means that a movement has been detected.	 Blinking once: Position acquisition Blinking twice: 2D-Fix (no valid height) Blinking three times: 3D-Fix (GPS data is complete) After start up as well as after a phase without GPS reception the device only accepts 3D GPS positions This ensures, that 2D positions reports with serious deviations from the real position are not reported to the control center. After a while, 2D position reports are accepted because the GPS receiver then had enough time to evaluate the signal quality of all available GPS satellites. A very short flash every 2 seconds indicates that the device is in sleep mode

Table 5: LED Behaviour

6 Troubleshooting hints

6.1 The device cannot connect to a GSM network

Possible issue source	Trouble shooting
The unit is not connected correctly to your vehicle	Please connect the unit to the vehicle according to the information in this manual
On-board power supply failure or defective internal fuse	You cannot fix this problem yourself. These fuses should protect the device and the periphery and only get damaged by extensive surcharge. You have to send the device to Telic or to your supplier.

Table 6: The device cannot connect to a GSM network

6.2 The device doesn't log into the GPRS network

Possible issue source	Troubleshooting
The Telic SBC-AVL isn't in a GSM covered area.	Please check whether there is GSM reception in this area (e.g. using a cell phone) and move eventually to another area.
The SIM card in the SBC-AVL is new and has not yet been activated	Please check, whether the SIM card is already activated. This can be done e.g. by putting the SIM card in your cell phone and checking whether or not your cell phone is able to log into a GSM network.
The SIM card has been locked by the provider.	Please check whether the SIM card is locked. This can be done e.g. by putting the SIM card into your cell phone and checking whether your cell phone is able to log into a GSM network. Is this not the case, than please try to make a phone call. If you are successful, the SIM card is definitely not locked.
The prepaid bonus is exhausted.	Please recharge the SIM card placed in the device.
The prepaid SIM card is no longer valid.	Prepaid SIM cards will lose their validity, if they aren't reloaded on a regular basis (often after 12 or 24 months). In this case usually you have to buy a new SIM card.
The PIN code of the card hasn't been deactivated Respectively The PIN on the SIM card is not corresponding to "0000".	Please remove the SIM card from the device and check the PIN code. The PIN code has to be deactivated or has to be set to "0000". After a triple wrong entry of the PIN, unblocking the SIM card requires the PUK.
The SIM card hasn't been inserted into the SIM card holder in the correct way.	Please check the correct position of the SIM card in the card holder.
The GPRS service is not yet activated.	Please ask your provider whether the GPRS function is already activated for the SIM card in use.

Table 7: The device doesn't log into the GPRS network

6.3 The device doesn't receive GPS data

Possible issue source	Troubleshooting
The GPS internal antenna has no free sight to the sky.	Please be aware, that a GPS internal antenna needs always clear view to the sky. Look for a better installation place of the device inside the vehicle**.**
Your vehicle is placed in an unsuitable place.	Please consider that a GPS reception is only possible in case of free sight between the GPS receiver and the sky. Please put your car for the test in a more suitable place (no buildings nearby, outside of a garage / factory etc.)

Table 8: The device doesn't receive GPS data

7 Basic features

The device can be configured via serial cable by using the Telic Configuration tool otherwise remotely via SMS and GPRS. Please contact Telic GmbH to have more details about the configuration procedure.

7.1 Event Types

The SBC-AVL's primarily task is to transmit GPS position data, including additional status information via a TCP/IP connection to the tracking server. If a message can't be transmitted, it will be stored in the device to be transmitted later. There is a storage capacity of about 20.000 position messages. The following events will generate a position message which always contains the GPS position:

- Time event: The end of a time period of x seconds (x being configurable).
- **Distance event:** After a distance of x meters (straight line distance to the previous event) in any direction (x being configurable) has been travelled.
- **Angular course change event:** A direction change of a configurable minimum angle in x degrees (x being configured) at a configurable minimum speed of y km/h (y being configurable).

7.2 Connection Establishment Procedure

The GSM and GPS modules will power up after switching on the SBC-AVL device. After logging in into the GSM network the SBC-AVL will attempt to establish a GPRS communication link. Finally a TCP/IP connection to the tracking server will be established to transmit the event messages.

The selection of the GSM network operator will take about 1 minute, plus the time to build up the GPRS- and TCP/IP-connections to the tracking server. Therefore, after switching on the device, it will take approximately 2-3 minutes until the first status message can be transmitted. Independent of this procedure, GPS positions and status information will be generated and stored in the internal memory for later transmission. Here follows the message structure.

7.3 Event Message Structure

The first identified and valid GPS position will be taken as the reference position for the distance interval calculations. The next distance interval event will be generated if the configured distance has been reached. If another event (e.g. time interval event) has been generated before, the distance interval measurement starts again at the position of this new event. That means that any position message with an actual GPS position sets a new reference for the distance interval calculations. This reduces the number of messages sent while still keeping the desired resolution of the tracking application.

A position message will also be generated in the case of a direction change being greater than the configured angle while travelling at the configured minimum speed.

Switching on and off the external Power supply (e.g. ignition on/off) also leads to an event message. The last valid position will be transmitted when no new valid GPS position is available.

Content	Description
Event/Log -Code	Reason for the status message
Event/Log Timestamp	Time at which the event has happened
GPS Timestamp	GPS timestamp at the moment of fetching longitude and latitude
Longitude	Degree of longitude (default: in 100µ degrees; can be decreased to 1µ degrees precision)
Latitude	Degree of latitude (default: in 100µ degrees; can be decreased to 1µ degrees precision)
Fix Type	1,2 or 3, depending on the availability of satellites in view having a sufficient signal strength: 1D Fix (no valid data) 2D Fix (no height indication) 3D Fix (position message with height indication)
Speed over ground	Speed in km/h
Sats for calculation	Actual number of satellites which are used for calculation
Height	Height above sea level (in m)
Mileage	Mileage in meters
DigIns	4 digits e.g. 0010, if power source is connected
Analog Input 1	Value of the analogue input 1 (Battery voltage with a precision of 1/10 volts)
MotSens	Status of the motion sensor

Table 9: Content description

8 Advanced Features

In this paragraph are described some advanced features supported by the device, which might be requirement for different use cases.

8.1 Geofencing

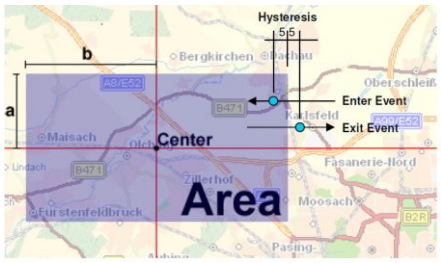

Figure 8: Geofencing

Geofencing (an electronic safety fence) provides the opportunity to set a geographic square around a defined location. Here you can set different scenarios like “leaving the area” or “entering the area” and transmit an event to the control centre. With the SBC-AVL you can monitor 50 geofence areas which can also be combined to create larger areas and build up a complex protection zone.Every geofence area is given an Area ID, a center (defined by its longitude and latitude) and a height and width (from the center not completely across) in meters.

8.2 Roaming alternative configuration

The device is able to detect a GSM roaming status and swap automatically to an alternative setup for roaming (this alternative setup has to be previously configured). This allows optimizing the data traffic and reducing the communication costs.

8.3 Input alternative configuration

The device is autonomously able to handle an alternative setup when a specific input is triggered (this alternative setup has to be previously configured). This can support features like “panic button”.

8.4 Device Watchdogs

The SBC-AVL has different integrated watchdogs. They automatically check the functions of the device and generate resets as soon as they recognise any malfunction. Malfunction could occur due to internal problems of the device, problems related to the GSM connection, problems with the GPS reception and many more.

This watchdog concept ensures that the SBC-AVL can automatically return to stable operation if necessary. Control of the watchdogs by the user is not necessary.

If the watchdog has to restart the device it may happen that some of the position messages and respectively events are not logged and as a result they are not transmitted to the tracking server.

8.5 GSM Jamming detection feature

The SBC-AVL Power is able to detect a GSM jamming attempt and activate therefore the digital output, which can be configured to a siren or light of the vehicle to generate an alert. A specific event will be generated and transmitted to the receiver as soon as the GSM network coverage returns available

8.6 Glonass enabling

The SBC-AVL Power obtains the fix per default based on GPS system. It is possible to send a command in order to force the device to use the GLONASS positioning system instead of GPS.

8.7 1-Wire

A 1-wire interface is available on the SBC-AVL Power, which allows ID-Button for driver recognition and the connection of up to 8 temperature probes. The following Temperature sensors are supported:

- DS18S20; DS18B20; DS1921G

8.8 CAN Bus (Only for SBC–AVL)

Any CAN BUS hardware can be interfaced to the device in order to extract additional information from the CAN bus line of the vehicle. Main applications are related to FMS standard for trucks or ODBII for cars. Dedicated configurations can be defined to retrieve additional data from the CAN bus. Please contact Telic technical support to discuss in more detail your use case requirements.

8.9 RS232 (Only for SBC–AVL Power)

The SBC-AVL Power supports transparent mode for the RS232 interface, and can therefore interface with a wide range of external peripheral devices.

The RS232 interface supports TTL Low Voltage (at 3.3 V). An external level shifter is required to support 12V RS232 logic level.

8.10 Additional Features

	A lot of additional features are available on SBC-AVL. Please contact the Telic Technical Pre-Sales support in case that your specific use case requires features which aren't described in this document.

9 Connect to the vehicle

This paragraph describes the procedure to install the device on board of your vehicle and check if the installation has been performed properly

	Please take proper ESD protection measures (e.g. electrical connection of the body to ground) to make sure you don't destroy internal electronics! Repair of ESD damages caused by users negligence will not be covered by Telic's warranty. Electrostatic discharge (ESD) is the sudden and momentary electric current that flows between two objects at different electrical potentials normally caused by static electricity.

9.1 Placing the device into the vehicle

In order to protect your vehicle from theft and vandalism the device should be installed in a location where it and its power supply are well-hidden. Using the cable-cases on box surfaces, please install the device in a suitable, dry location, not in contact to radio and audio frequency interference or hot parts of the vehicle like near the engine. When installing the device please consider that antennas are integrated, this means it must be installed in a place with a minimum distance of 7 cm to metallic components of the vehicle in each direction. In order to optimize the quality of the signal received, the surface of the internal GPS internal antenna must be installed looking at the sky (see the label indication on the device box-this side up).

9.2 Wiring connection

Please connect the Telic SBC-AVL remote control unit to the vehicle according to the following instructions using the connection cable. Please do not connect the connector to the Telic SBC-AVL remote control unit before all cables you intent to use are connected to the vehicle. The power supply has to be available while the ignition is off.

The black wire (pin 6 on molex connector) must be connected to the GROUND (pin 31 of the vehicle) and the red wire (pin 1 on molex connector) must be connected to VCC (pin 30 of the vehicle).

The yellow wire (pin 5 on molex connector) must be connected to ignition (pin 15 of the vehicle).

All other wires have to be connected to the related interface, otherwise please ensure that they can not cause short circuit.

The advantage of constant power supply is that the device is able to connect faster to the GSM network and it can find faster a new GPS position after ignition was switched from "OFF" to "ON". This means that for example working time calculations will be more precise. With ignition off the power consumption of the Telic SBC-AVL is low enough that it does not interfere with proper functionality of the vehicle battery.

If the Telic SBC-AVL remote control unit is configured to use a motion dependent power mode, the device can detect and report that it is moving (e.g. if it is stolen or being transported via a second vehicle) even while ignition is off.

10 Safety

The following guidelines must be followed in order to ensure the safety of users. If these rules are ignored Telic will not assume responsibility for any damages that are encured.

10.1 General Battery handling

Because the SBC-AVL main power source is a battery with high energy content. They are designed to represent the highest possible degree of safety. They may, however, present a potential hazard if they are abused electrically or mechanically. This is in most circumstances associated with the generation of excessive heat. In this case the internal pressure may cause the cell case to rupture.

As a result the following general guidelines should be followed when handling the SBC-AVL Battery:

- Do not short-circuit
- Do not over discharge
- Do not incinerate
- Do not expose to temperatures beyond the specified
- temperature range
- Do not crush or puncture
- Do not open cells, do not disassemble battery packs
- Do not expose contents to water
- Do not connect with false polarity
- Do not weld or solder to the battery's body

It is very important that only authorized official Telic replacement batteries be used in the SBC-AVL. Also the batteries included with the devices are only tested or authorized for use in the SBC-AVL. The batteries should never be used in any other devices unless specifically authorized by Telic, including but not limited to other Telic products or devices.

10.2 Battery storage

Batteries should be stored in rooms with generally low temperature and low humidity levels. While it is not essential that these storage areas be temperature and humidity controlled, temperatures should generally be kept below 35 $^{\circ}$ C and storage areas should be well ventilated. Storage temperatures above 75 $^{\circ}$ C should be avoided.

Your SBC-AVL batteries should be stored in their original packaging materials or in the SBC-AVL itself. This will eliminate unintentional shorting. Do not store batteries in conductive anti-static bags or foam unless the resistivity of the material exceeds 1 MΩ. Batteries should not be placed on or covered with metallic or otherwise conductive material.

Batteries should be stored away from any flammable material in the storage area. Fire extinguishers for metal fire (class D) are preferred. Do not attempt to extinguish fires with small amounts of water, sand, or with carbon dioxide extinguishers.

10.3 Battery disposal

The disposal or recycling of batteries is regulated by each European country. In each country, the manufacturers, importers and users are responsible for the proper disposal. The European Community (EC) has issued two directives, 91/157/EEC and 93/86/EEC. These directives are implemented by each member country of the EC independently and in a different way. In accordance with these directives, The SBC-AVL Batteries do not contain dangerous substances. The reaction products are inorganic and do not represent environmental risks once the decomposition process has terminated.

11 General Terms and Conditions

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12 Documentation change LOG

Revision	Date	Changes
Rev. 2.0	06/02/14	First release on new layout
Rev. 2.1	26/05/14	Layout Update
Rev. 2.2	25/08/14	Updated SBC-AVL specific information
Rev. 2.3	01/01/15	Updated Sections 1, 4 and 5.4.1. New Chapter 2 to identify applicable products.
Rev. 2.4	05/07/15	Updated Sections 3 & 4

Table 10: Documentation change LOG